

Extreme coastal flood in a context of Sea Level Rise: how to prevent death ?

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Xynthia hits Atlantic French coast during the night of February, 28th, 2010

- 41 deaths by drowning due to the coastal flood:

➔ are death location due to fate ?

➔ Is it possible to map places where future death can occurs?

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- Following the crisis: **«black zones»**

= destruction of dangerous houses

➔ what about other safety measures ?

La Faute-sur-Mer and L'Aiguillon-sur-Mer, 03/03/2010



Crédits : D. Mercier, 2011

1. Topographie et submersion potentielle

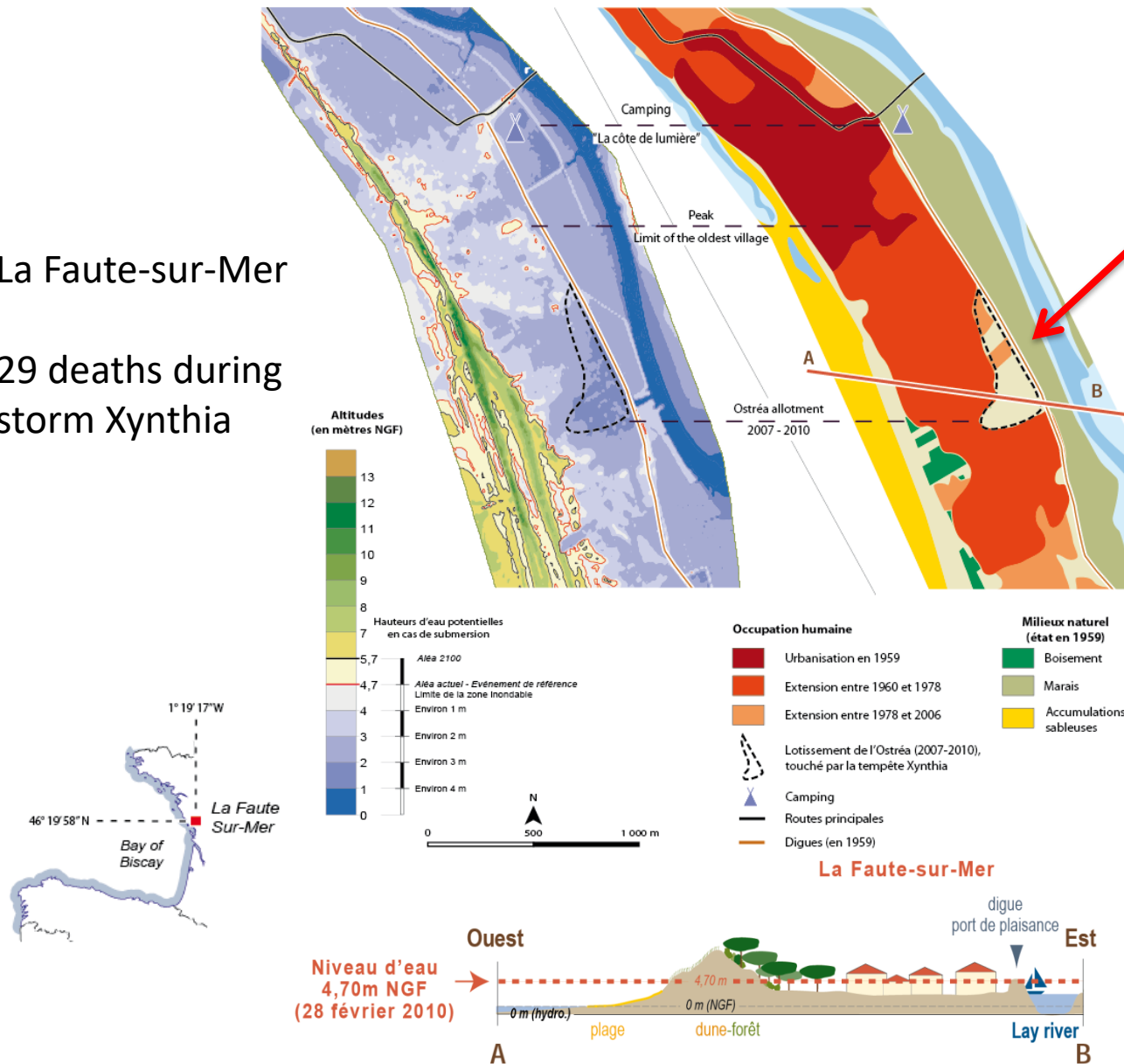
2. Dynamique de l'urbanisation (entre 1959 et 2010)

Source : Chadenas C., Creach A., Mercier D. (2013). *The impact of storm Xynthia (2010) on French coastal risk management*, Journal of Coastal Conservation and Management

La Faute-sur-Mer

29 deaths during storm Xynthia

28 deaths during storm Xynthia

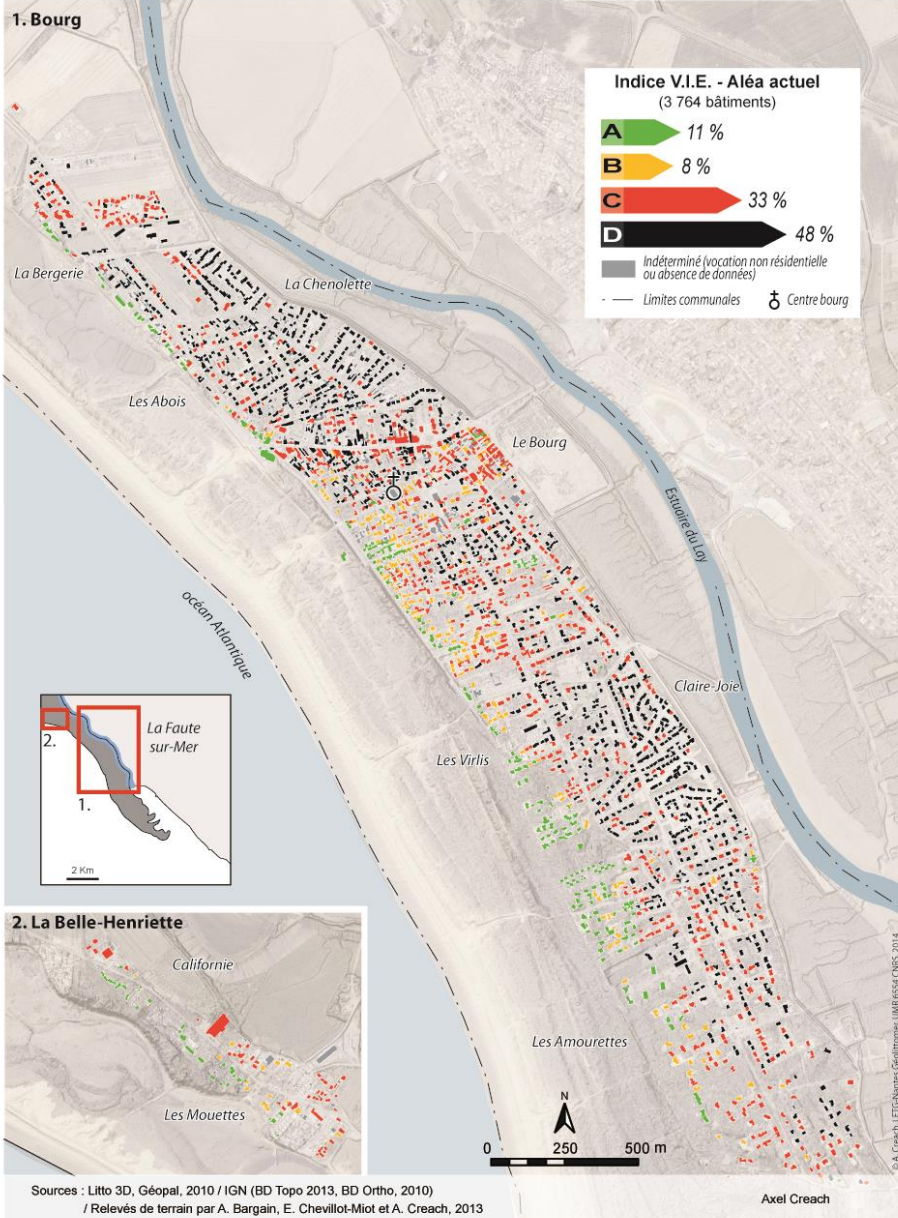


Extrait de Chadenas C., Chauveau E., Mercier D., Pottier P., Comentale B., Pourinet L., La tempête Xynthia du 28 février 2010 sur les côtes vendéennes, Atlas Permanent de la Mer et du Littoral – Golfe de Gascogne, LETG Nantes-Géolittomer, n°6 2012, 50p. Sources: IGN, cartes topographiques de 1950, 1978 et 2006 (1:25 000 et 1:50 000)

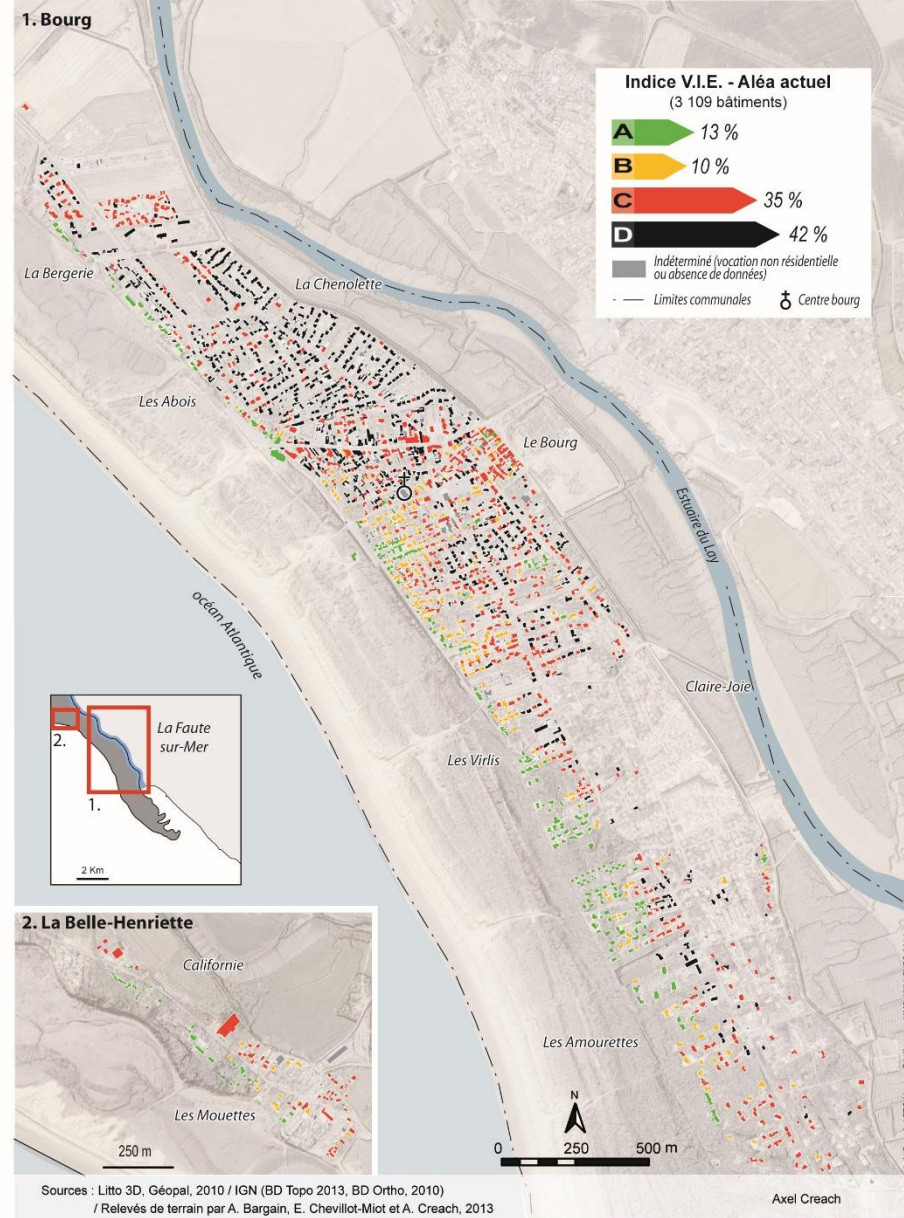
La Faute-sur-Mer: a « end of the world »



Indice de Vulnérabilité Intrinsèque Extrême (V.I.E.) La Faute-sur-Mer (Scénario " actuel " - 4,70 m NGF)



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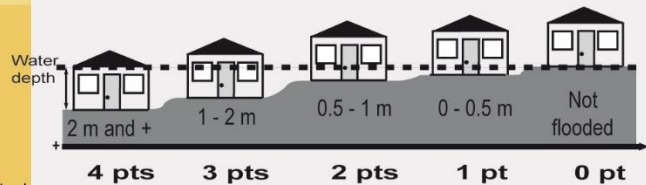
Part 1

A tool to locate potential death areas due to coastal flood: the V.I.E. Index



Parameters

Exposure to coastal flood event (Exp)



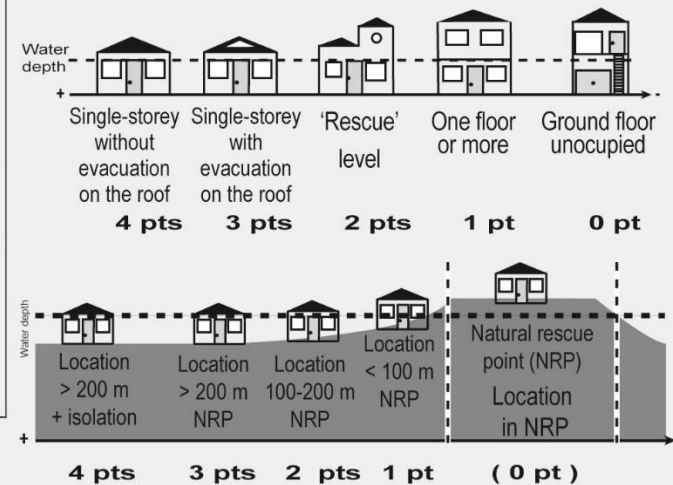
Cr1
Potential water depth
DEM
Hazard level

Cr2
Distance to flood defences
Buffer

Characteristics of buildings (Chr)

Cr3
Architectural type
Architectural typology

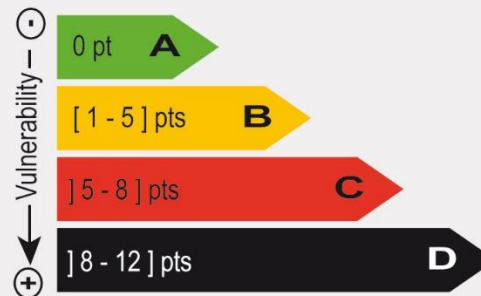
Cr4
Closeness to rescue point
DEM



V.I.E. Index (Extreme Inherent Vulnerability)

$$V.I.E. = f \{ (Cr1 \times 2/3 + Cr4 \times 1/3) + Cr2 + Cr3 \}$$

If Cr1 = 0 then V.I.E. = 0



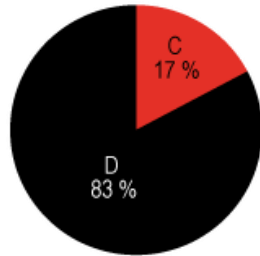
Criteria Weighting GIS tool

Index formula

Mapping

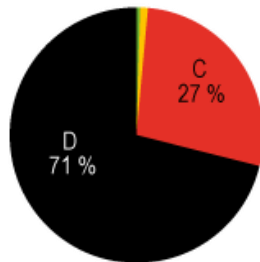
Validation using Xynthia's lessons

1 – Deaths

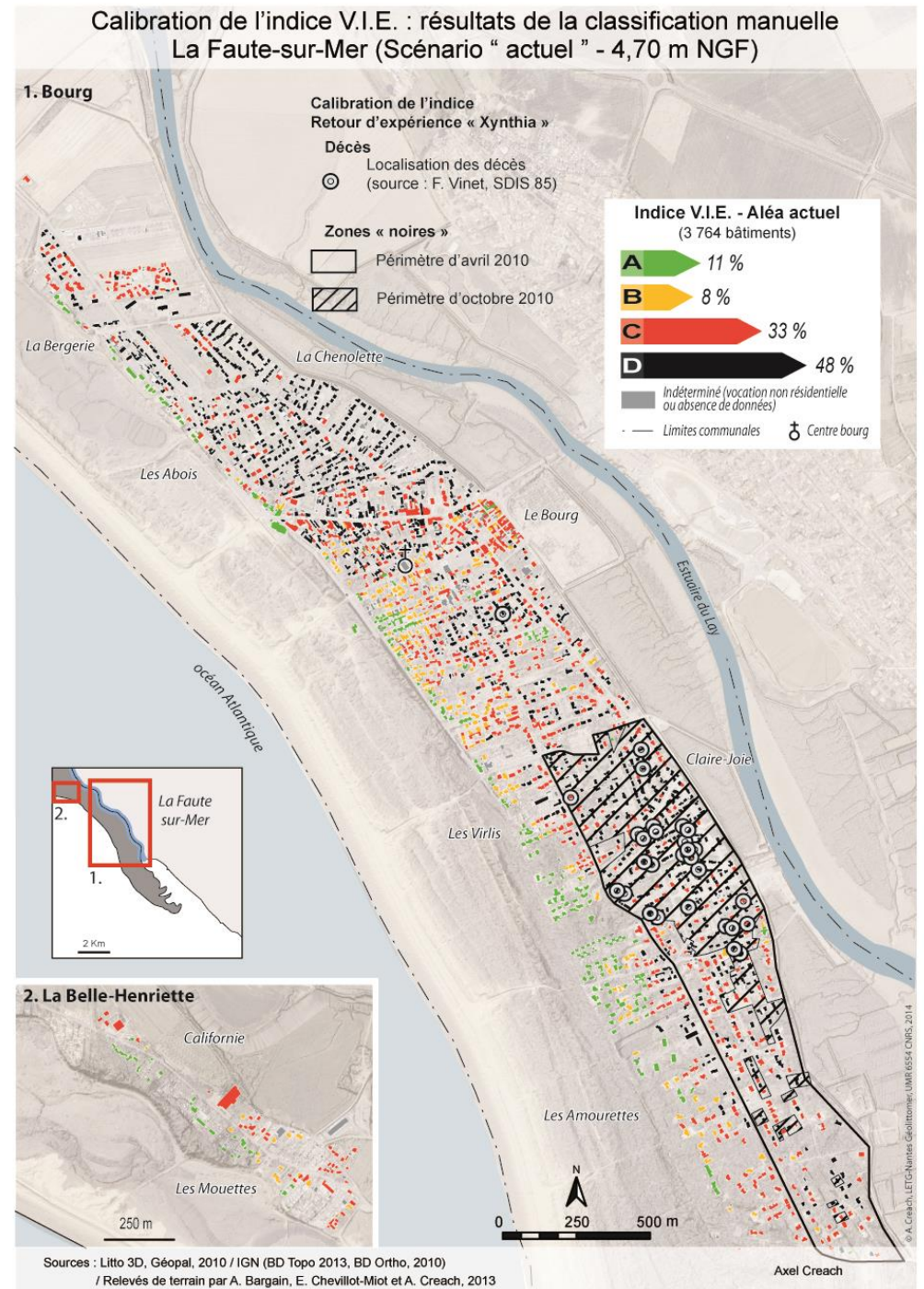
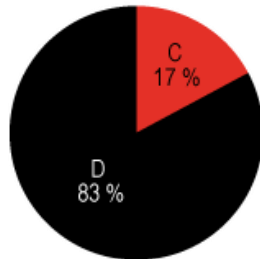


2 – Black zones area

April 2010

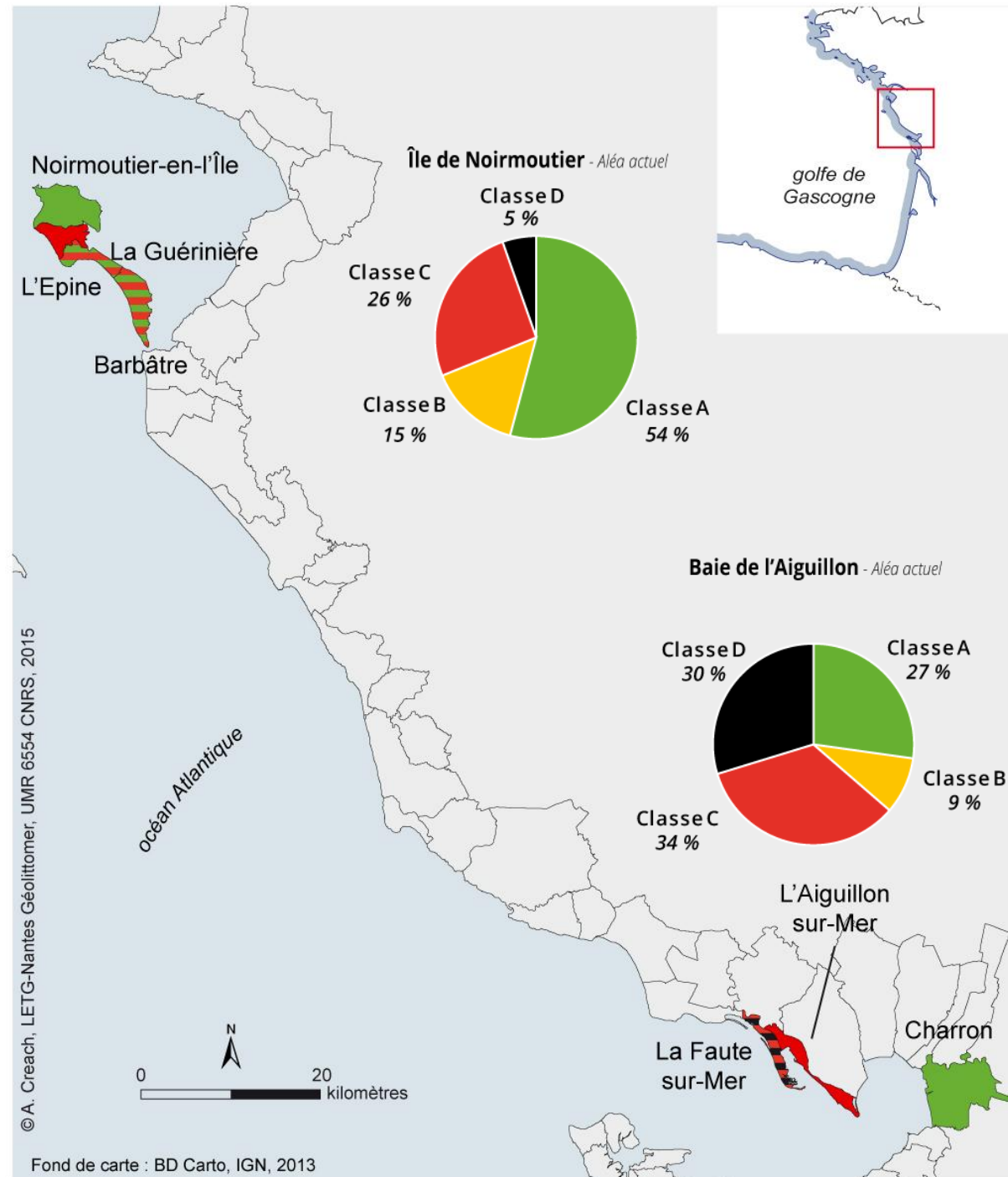


Octobre 2010



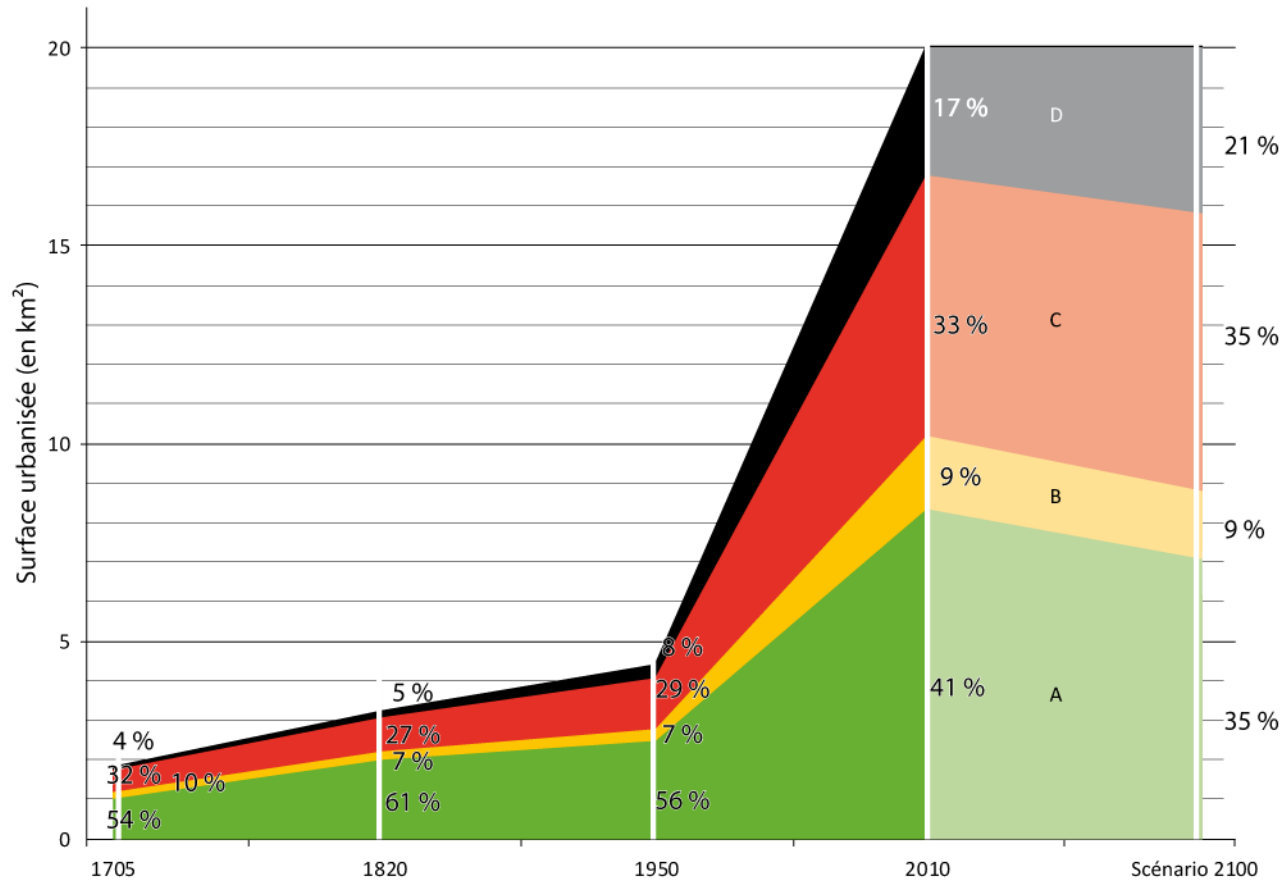
Synthesis of VIE index result's

Differences between Baie de l'Aiguillon and Noirmoutier Island



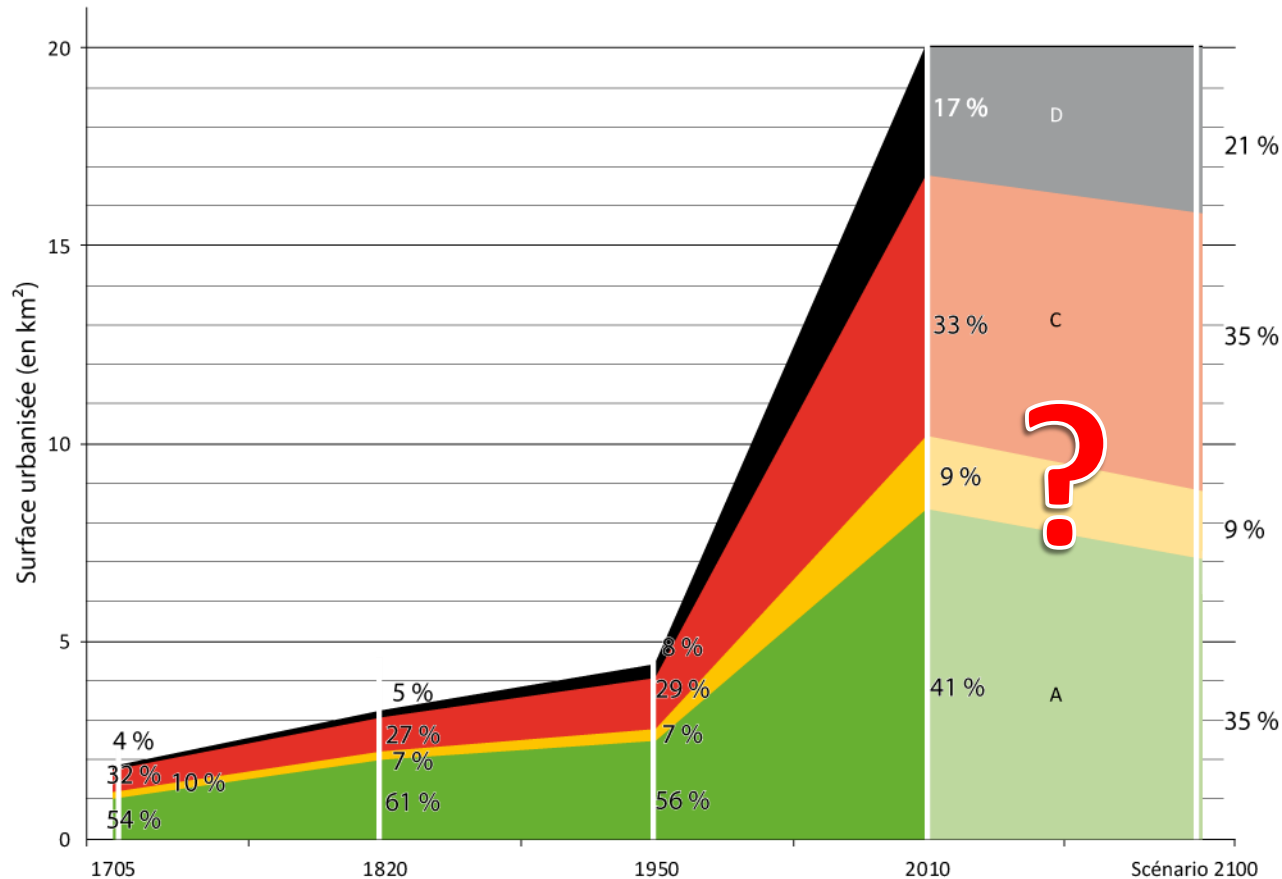
Is vulnerability increasing ? Which future with SLR ?

Evolution of VIE index results between 1705 and 2010 and projection for 2100



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Evolution of VIE index results between 1705 and 2010 and projection for 2100

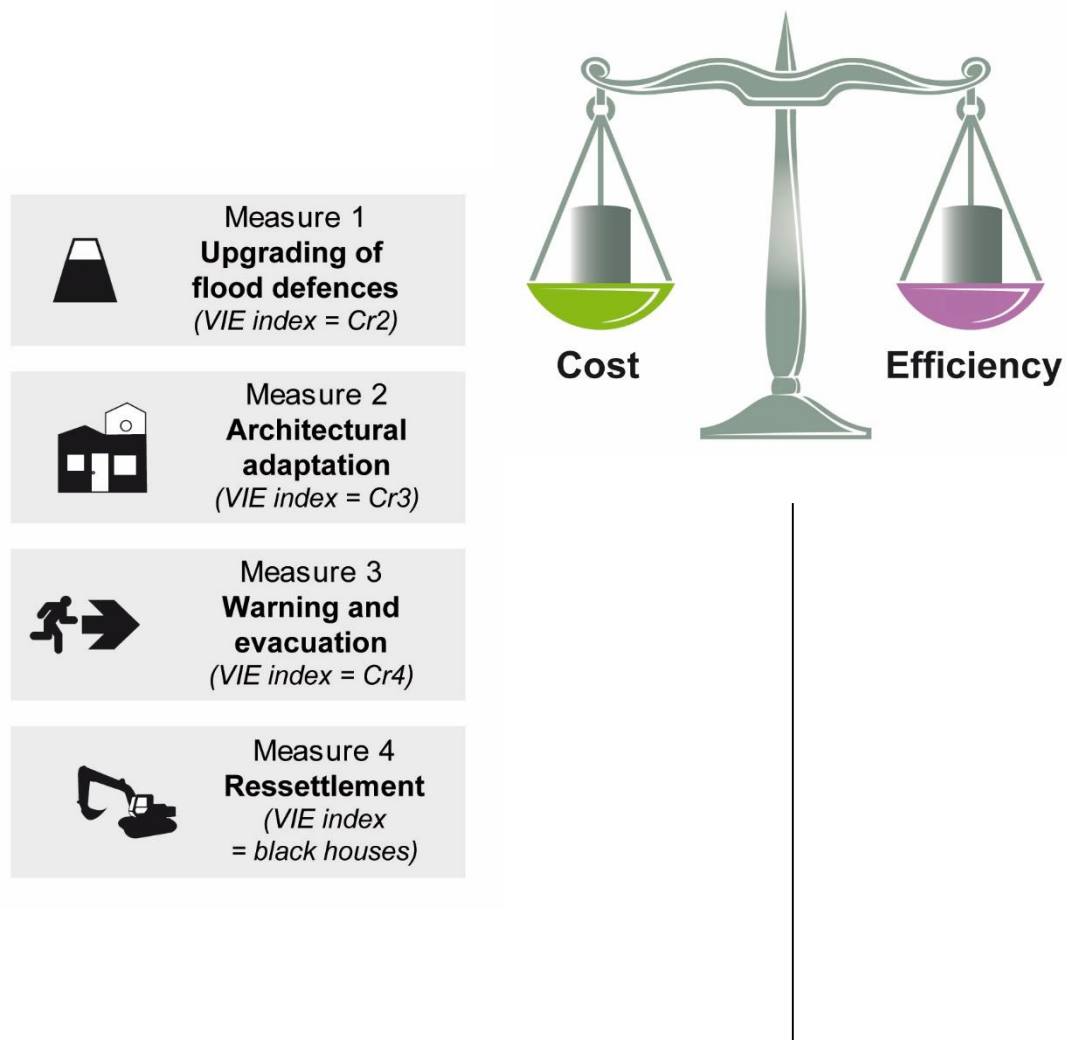


Part 2

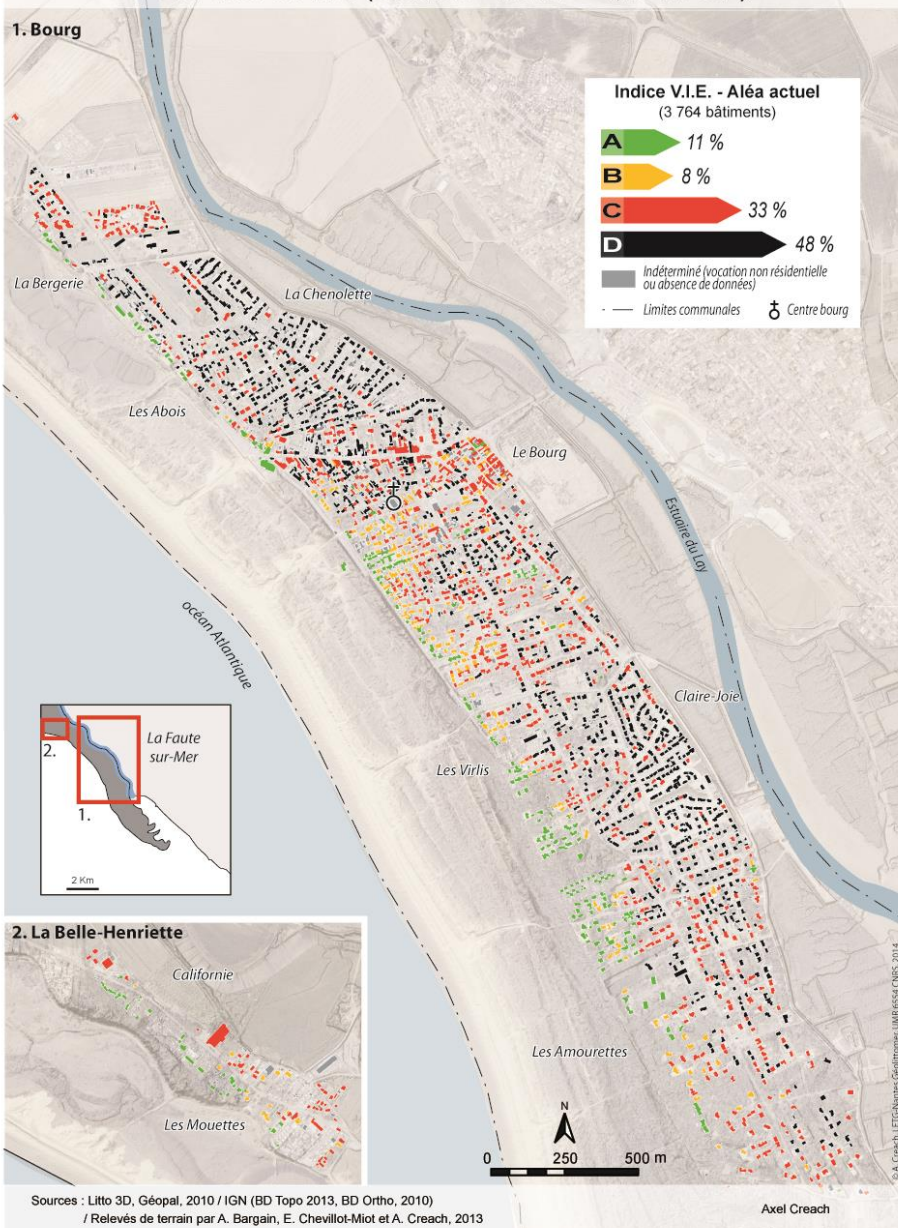
Economic appraisal of vulnerability reduction scenarios to coastal flood risk: how to save human's life in spending less money?



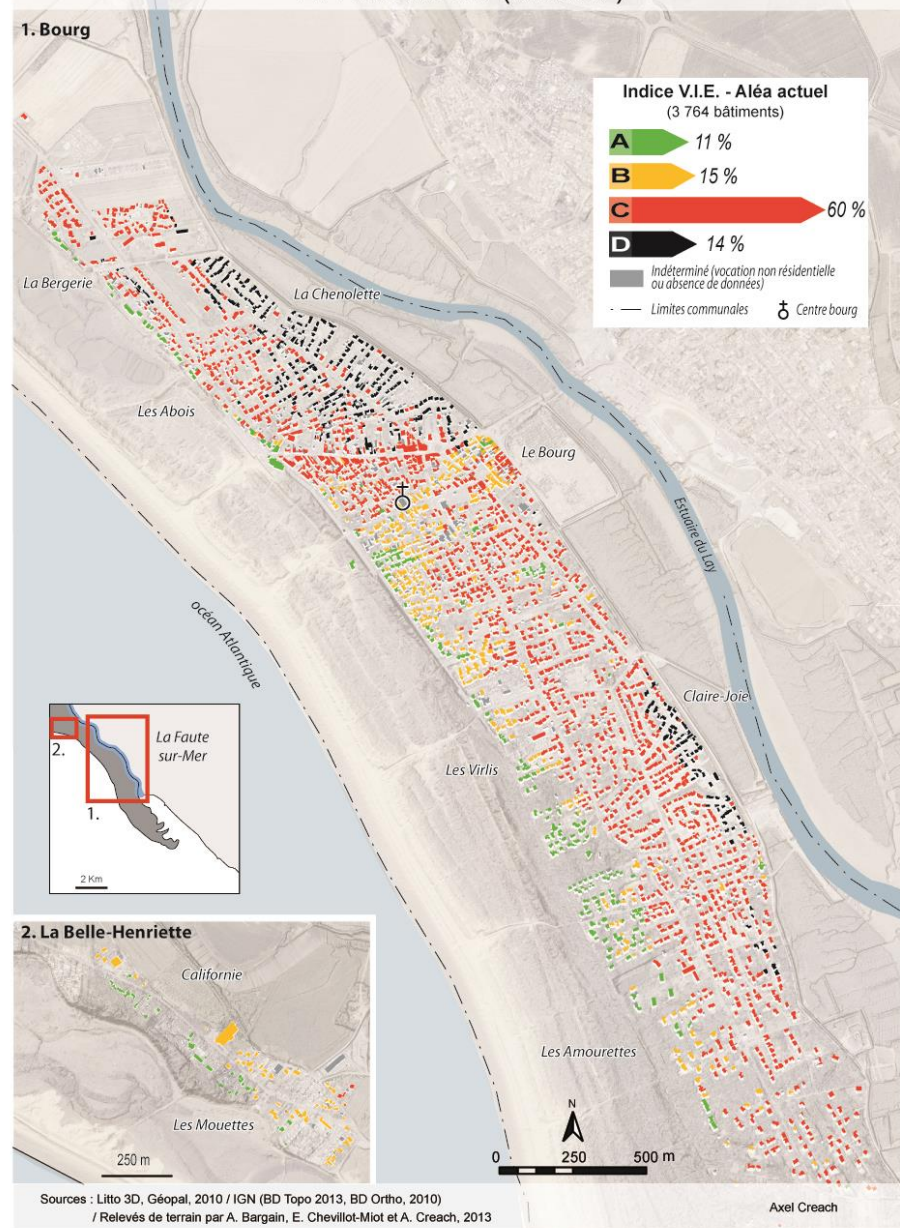
Cost-Efficiency analysis of 4 measures to reduce building vulnerability for people



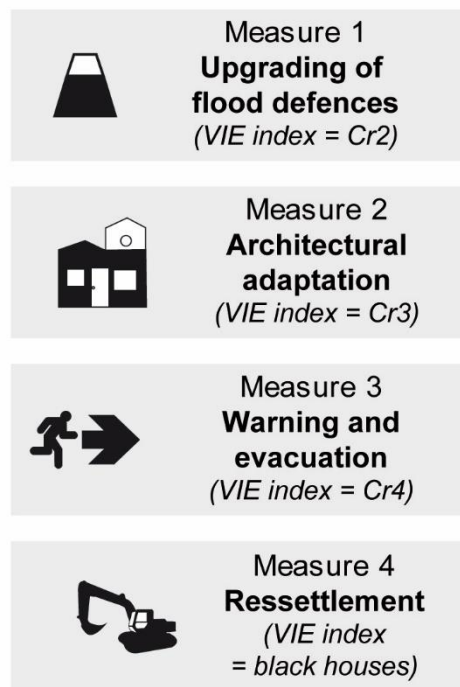
Indice de Vulnérabilité Intrinsèque Extrême (V.I.E.) La Faute-sur-Mer (Scénario " actuel " - 4,70 m NGF)



Indice de Vulnérabilité Intrinsèque Extrême (V.I.E.) La Faute-sur-Mer (Mesure 2)

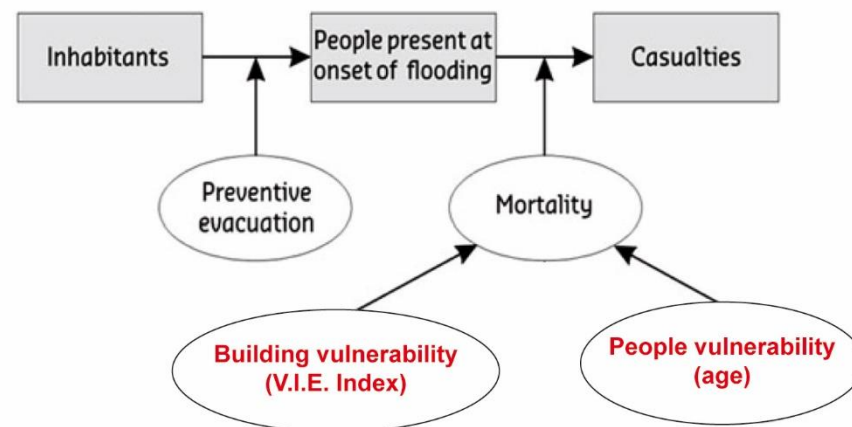


Cost-Efficiency analysis of 4 measures to reduce building vulnerability for people



Efficiency:
Number of life saved per measure

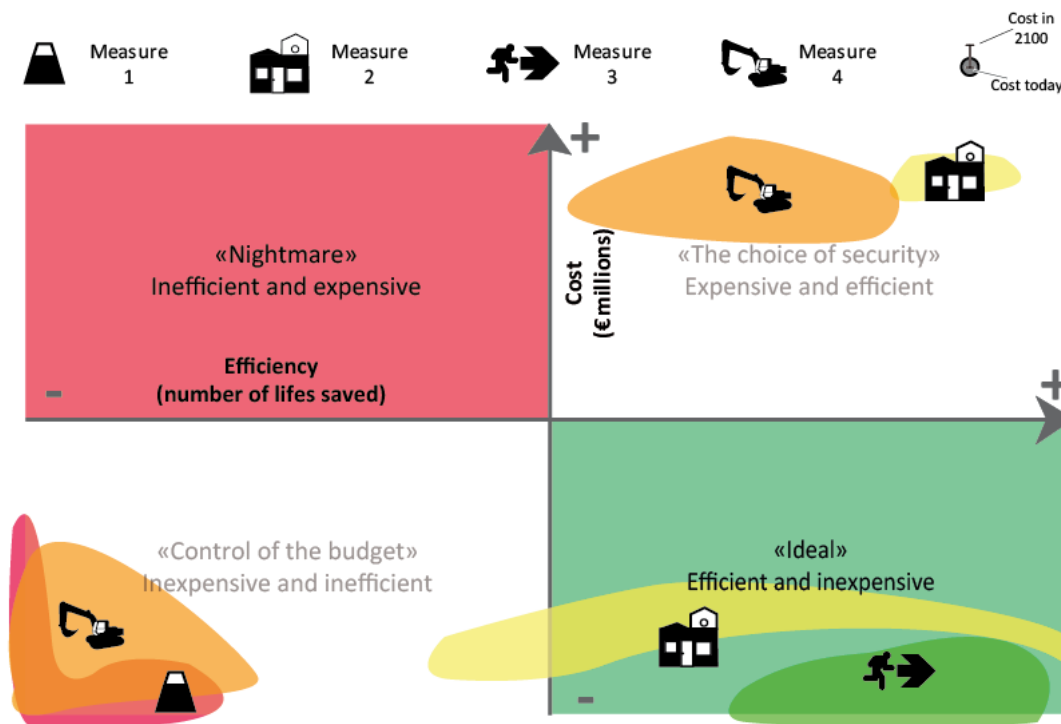
Mortality functions
(Jonkman *et al.*, 2008)



Adapted from Di Mauro *et al.*, 2012

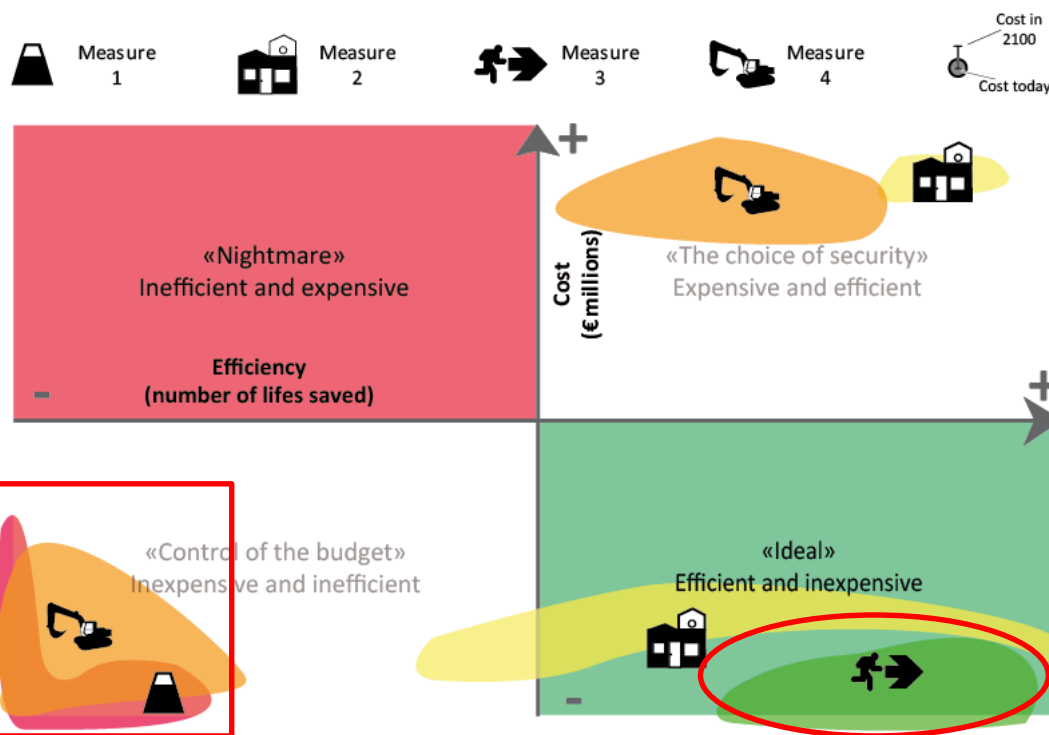
Synthesis: importance of prevention, warning and evacuation

Cost / Efficiency (€ millions)	Measure1 		Measure 2 		Measure 3 		Measure 4 	
	Actual event	2100 event	Actual event	2100 event	Actual event	2100 event	Actual event	2100 event
Today	1.2	1.2	1.9	2.4	0.2	0.2	9.4	10.3
20 years	1.5	1.5	1.9	2.4	0.3	0.3	9.4	10.3
50 years	1.7	1.8	1.9	2.4	0.4	0.3	9.4	10.3
100 years	1.9	1.9	1.9	2.4	0.5	0.4	9.4	10.3



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This result is valid only in order to protect human life!

Efficient if 75% of people really evacuated = realistic ?

1) VIE Index

- ➔ Micro-scale level and easy-to-use tool
- ➔ But use a static flood model (over-estimate water levels)

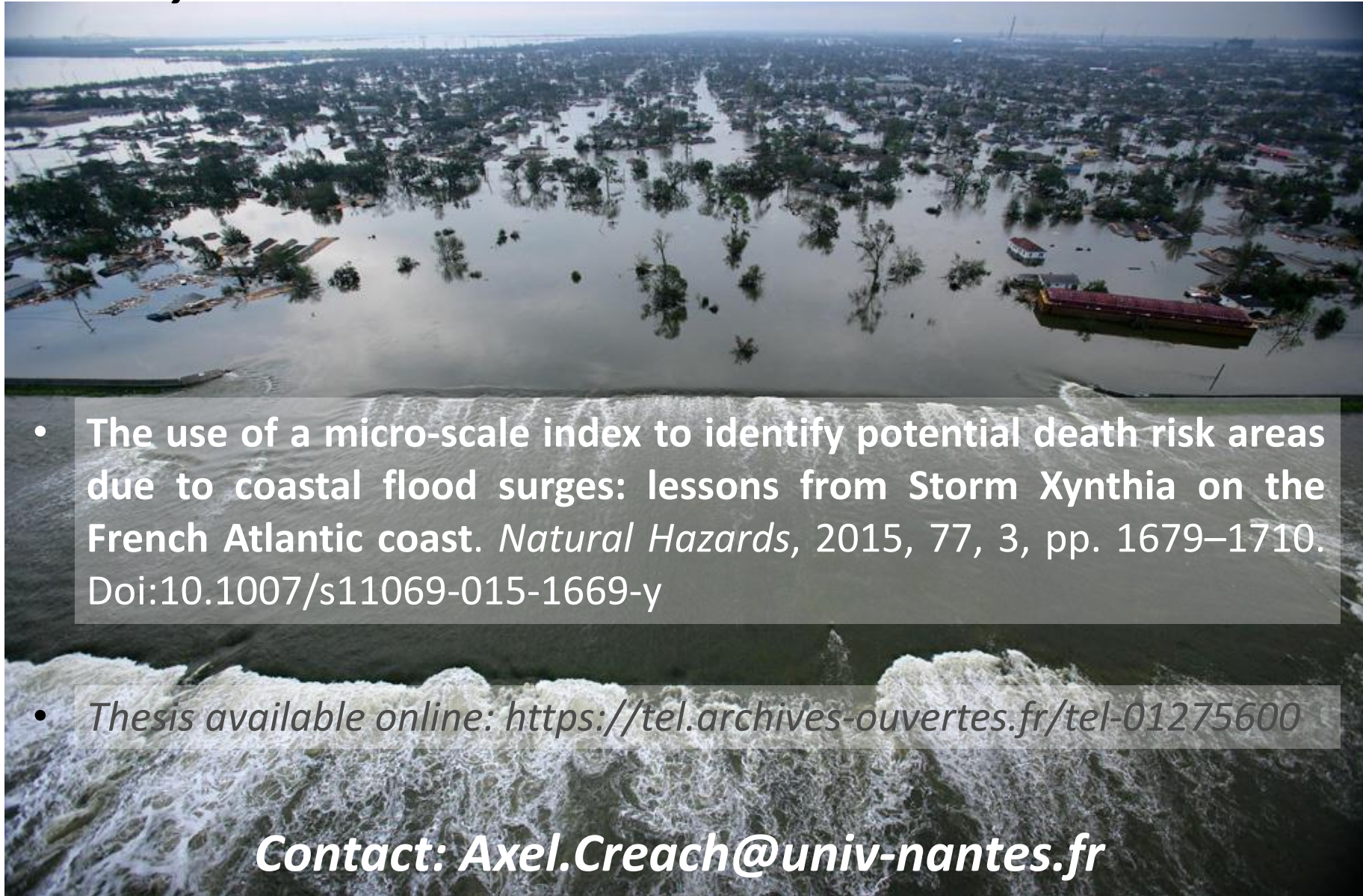
2) CEA

- ➔ A tool for decision support at micro-scale
- ➔ More prevention + structural measures depending of level of vulnerability

3) Application

- Rescue teams
- Land use planning (European Flood directive)

Thank you !



- The use of a micro-scale index to identify potential death risk areas due to coastal flood surges: lessons from Storm Xynthia on the French Atlantic coast. *Natural Hazards*, 2015, 77, 3, pp. 1679–1710. Doi:10.1007/s11069-015-1669-y
- Thesis available online: <https://tel.archives-ouvertes.fr/tel-01275600>

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